

CATEGORIES USED FOR GARCIA AND ASSOCIATES FAUNAL IDENTIFICATIONS

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MISCELLANEOUS

Artifact.....any historically manufactured item as well as any geological, vegetal, osteological, or other material obviously or possibly intentionally "worked", including bones showing apparent butchering marks.

NONVERTEBRATE

Basalt.....all nondisintegrated volcanically derived material, including pumice, and volcanic glass fragments not included under "Artifact".

Inorganic.....usually, geological material not included under either "Artifact" or "Basalt".

Charcoal

Vegetable.....all uncharred or otherwise unmodified vegetal material.

Coral Reef Rubble.....including fragments of mollusk, echinoderm, etc., that seem obviously to have weathered out of the reef or to be quite beachworn, and thus probably not human food midden.

Coral.....nonfossil material that seems to have entered the deposit in a relatively fresh condition, although sometimes beach-worn.

Echinoderm.....usually, exoskeleton remains of sea urchin, quite possibly mostly being human food midden.

Mollusk.....nonfossil material of marine, freshwater, and/or terrestrial forms that seems to have entered the deposit in a relatively fresh condition, most of the nonterrestrial material probably being human food midden.

Crustacean.....usually, exoskeleton remains of crab or lobster, with an occasional barnacle plate, much--but not all--probably being human food midden.

Invertebrate.....remains of invertebrate groups either not more specifically identifiable, or other than those listed above; for example, bryozoan exoskeletons, calcareous polychaete worm tubes, insects, etc.

VERTEBRATECLASS CHONDRICHTHYES (Sharks and Rays) AND/OR CLASS OSTEICHTHYES (Bony Fishes)

[Arrangement and nomenclature follow Gosline, W.A., and V.E. Brock, 1960 (reprinted 1965), *Handbook of Hawaiian Fishes*, University of Hawaii Press, Honolulu.]

Shark.....not identified to any lower taxonomic level; in Hawai'i there are 9 families comprising about 22 species.

Ray.....not identified to any lower taxonomic level; in Hawai'i there are 3 families comprising about 5 species.

Albulid.....member(s) of the family Albulidae (Bonefishes), of which there is a single species reported for Hawai'i; usually found near shore in open sand-bottomed areas, and reaching about 100 or more cm in length.

Synodontid.....member(s) of the family Synodontidae (Lizardfishes), of which there are 9 species in Hawai'i; primarily inshore bottom-dwellers of reefs and mud or sand substrates, and reaching 30 cm in length.

Muraenid.....member(s) of the family Muraenidae (Moray Eels), of which there are over 35 species in Hawai'i; some reaching a length of 150 cm.

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Congrid.....member(s) of the family Congridae (Conger Eels), of which there are at least 7 species in Hawai'i; some reaching a length of 150 cm.

Marine Eel.....member(s) of 1 (or more) of the 10 eel families recorded for Hawaiian waters, of which the Muraenidae (Moray Eels), Congridae (Conger Eels), and Ophichthidae (Snake Eels) are by far the most speciose and frequently encountered groups.

Fistulariid.....member(s) of the family Fistulariidae (Cornetfishes), of which there is a single species in Hawai'i; primarily a reef-dweller reaching over 100 cm in length.

Aulostomid.....member(s) of the family Aulostomidae (Trumpetfishes), of which there is a single species in Hawai'i; primarily a reef-dweller reaching about 70 cm in length.

Holocentrid.....member(s) of the family Holocentridae (Squirrelfishes), of which there are about 15 species in Hawai'i; many of them found in deeper reef areas, with most of them fairly small and only 1 or 2 approaching 45 cm in length.

Carangid.....member(s) of the family Carangidae (Jacks), of which there are over 20 species in Hawai'i; most of them deeper-water and fairly large forms; the species *Caranx ignobilis* (Ulua--or Pāpio for the smaller young) sometimes ranging in close to shore, and reaching 100 cm or more in length.

Mullid.....member(s) of the family Mullidae (Goatfishes), of which there are 10 species in Hawai'i; many of them living on the reef or frequently visiting it, usually about 20-25 cm long but a few reaching 40-60 cm.

Chaetodontid.....members of the family Chaetodontidae (Butterflyfishes), of which there are between 25 and 30 species in Hawai'i (including 8 species separated as the family Pomacanthidae [Angelfishes] by some authors), most often inshore reef forms, reaching no more than about 30 cm in length.

Cirrhitid.....member(s) of the family Cirrhitidae (Hawkfishes), of which there are 5 or 6 species in Hawai'i; all inshore forms, only 1 of which reaches as much as 30 cm in length.

Labrid.....member(s) of the family Labridae (Wrasses), which is the largest family of fishes in Hawai'i with over 40 species; predominately inshore forms, most of them fairly small but with a few larger forms reaching about 50 cm in length.

Scarid.....member(s) of the family Scaridae (Parrotfishes), of which there are 7 species in Hawai'i; typically inshore forms, and including 1 or 2 species that may reach 70 cm in length.

Acanthurid.....member(s) of the family Acanthuridae (Surgeonfishes), of which there are over 20 species in Hawai'i; most of them inshore forms, with the genus *Naso* (Unicornfish or [mostly] Kala) comprising the 5 generally largest of these, reaching 40 to 75 cm in length.

Scombrid.....member(s) of the family Scombridae (Tunas and Mackerels), of which there are perhaps a dozen species in Hawaiian waters; almost all open-ocean (pelagic) forms, many reaching a m or more in length.

Scorpaenid.....members of the family Scorpaenidae (Scorpionfishes), of which there are perhaps as many as 25 species in Hawai'i; a majority of them inshore, and fairly small (8-15 cm), forms, although several species may reach between 25 and 50 cm in length.

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Balistid.....member(s) of the family Balistidae (Triggerfishes), of which there are about 10 species in Hawai'i; mostly inshore forms, with the largest reaching about 35 cm in length.

Monacanthid.....member(s) of the family Monacanthidae (Filefishes), of which the small *Pervagor spilosoma* (Fantail Filefish), reaching only about 15 cm in length and sometimes washing up on beaches dead in great numbers, is by far the most abundant of the 8 species to be expected in near-shore Hawaiian waters; the genus *Alutera* contains the largest species, reaching about 60 cm in length.

Tetraodontid.....member(s) of the family Tetraodontidae (Smooth Puffers), of which there are about 5 species, ranging up to 50 cm in length, in Hawai'i (--or perhaps close to a dozen if the several, generally small, species of the genus *Canthigaster* [considered to constitute the family Canthigasteridae (Sharp-backed Puffers) by some authors] are included--); a few forms of both types of these puffers may be found in shallower inshore areas, and all of the species may possess an intrinsic poison although the flesh is apparently sometimes eaten without ill effects.

Diodontid.....member(s) of the family Diodontidae (Spiny Puffers), of which 2 species of the genus *Diodon*, ranging from 35 to 70 cm in maximum length, are by far the most abundant in Hawaiian inshore waters, the single remaining species reported for Hawai'i (genus *Chilomycterus*, 50 cm in length) apparently being quite rare here; all of these species are suspected of possessing an intrinsic poison although the flesh is apparently sometimes eaten without ill effects.

Fish.....material of indeterminate class and family, although essentially always a bony fish rather than shark or ray.

CLASS AMPHIBIA

Order Anura

Family Bufonidae: (True Toads)

Bufo marinus (Giant Neotropical Toad).....introduced to the Hawaiian Islands in 1932.

CLASS REPTILIA

Order Testudinata (Order Chelonia of some authors)

Family Cheloniidae: (Typical Sea Turtles) and/or Family Dermochelyidae: (Leatherback Sea Turtles)

Sea Turtle.....comprises fragmentary remains that could not be assigned to a particular one of the half-dozen species of marine turtle found in the Pacific; among the several cheloniids, *Chelonia mydas* (Green Sea Turtle) is possibly the most abundant and, apparently, the one most often taken for food; *Eretmochelys imbricata* (Hawksbill Sea Turtle) is usually found much less frequently and is apparently not eaten although the horny scutes of the carapace and plastron ("tortoise shell") are used artifactually; while the sole dermochelyid, *Dermochelys coriacea* (Leatherback Sea Turtle--which lacks the large flat bony plates of the carapace found in all other sea turtles) is an important egg-producer for human food purposes in Indonesia, Malaysia, and probably other areas of the Southwest Pacific, although it does not lay eggs in Hawai'i.

Order Squamata

Family Indeterminate

Small Lizard.....lizard(s) with a head-and-body length of less than about 10 or 15 cm; usually not identified to any lower taxonomic level although, in Hawai'i, most or all of the material probably represents the Polynesian-introduced(?) families Gekkonidae (geckos) and/or Scincidae (skinks) rather than any of the smaller members of historically introduced families.

CLASS AVES [Arrangement and nomenclature--unless modified by the various Olson and James' references listed below--of historically known forms follow Pratt, H.D., P.L. Bruner, and D.G. Berrett, 1987, *The Birds of Hawaii and the Tropical Pacific*, Princeton University Press, Princeton, New Jersey; while information on prehistorically extinct

(Categories for Garcia and Associates Faunal Ident's., A.C. Ziegler, rev. 12 May 2003, p. 4.)

forms is drawn from Olson, S.L., and H.F. James, 1982, Prodrum of the fossil avifauna of the Hawaiian Islands, *Smithsonian Contributions to Zoology*, No. 365; Olson, S.L., and H.F. James, 1991, Descriptions of thirty-two new species of birds from the Hawaiian Islands: Part I. Non-Passeriformes, *Ornithological Monographs* No. 45; and James, H.F., and S.L. Olson, 1991, Part II. Passeriformes, *ibid.* No. 46.]

Order Procellariiformes

Family Diomedidae: (Albatrosses)

Diomedea sp. (Albatross)

Family Procellariidae: (Shearwaters, Petrels, and Fulmars)

Puffinus pacificus (Wedge-tailed Shearwater)

Puffinus sp. (Shearwater).....member(s) of this genus that in Hawai'i most likely include the relatively small species *Puffinus nativitatis* (Christmas Shearwater) and, possibly, *Puffinus lherminieri* (Audubon's Shearwater; see Olson and James 1982:33), as well as the medium-sized species *Puffinus pacificus* (Wedge-tailed Shearwater) and *Puffinus newelli* (Newell's Shearwater).

Bulweria bulwerii (Bulwer's Petrel)

Pterodroma hypoleuca (Bonin Petrel)

Pterodroma phaeopygia (Hawaiian Petrel)

Pterodroma sp. (Petrel).....member(s) of this genus that in Hawai'i most likely include the relatively small species *Pterodroma hypoleuca* (Bonin Petrel) and the prehistorically extinct *Pterodroma jugabilis* (Gracile Petrel) of Olson and James 1991:17-22, as well as the medium-sized species *Pterodroma phaeopygia* (Hawaiian Petrel).

Small Procellariid.....smaller member(s) of the family Procellariidae, in the general size range of *Puffinus nativitatis* (Christmas Shearwater), *Bulweria bulwerii* (Bulwer's Petrel), *Pterodroma hypoleuca* (Bonin Petrel), as well as, possibly, *Puffinus lherminieri* (Audubon's Shearwater; see Olson and James 1982:33) and the extinct *Pterodroma jugabilis* (Gracile Petrel) of Olson and James 1991:17-22.

Medium Procellariid.....medium-sized member(s) of the family Procellariidae, in the general size range of *Puffinus pacificus* (Wedge-tailed Shearwater), *Puffinus newelli* (Newell's Shearwater), and *Pterodroma phaeopygia* (Hawaiian Petrel).

Order Anseriformes

Family Anatidae: (Swans, Geese, and Ducks)

Branta sandvicensis (Hawaiian Goose)

Medium Anatid.....member(s) of the family Anatidae in the general size range of smaller geese and larger ducks, such as *Branta sandvicensis* (Hawaiian Goose) and continental races of *Anas platyrhynchos* (Mallard).

Order Falconiformes

Family Accipitridae: (Eagles and Hawks)

Buteo solitarius (Hawaiian Hawk)

Order Galliformes

Family Phasianidae: (Turkeys, Peafowl, Guineafowl, Chickens, Pheasants, Quail, etc.)

Gallus gallus (Red Junglefowl [=Chicken]).....(in almost all cases, fragmentary material representing pre-Contact Polynesian junglefowl would not be distinguishable from that of historically introduced chicken breeds of this same species. Also, I am not sure that most such material of other phasianids such as various species of larger pheasants

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[*Phasianus*, *Lophura*, etc.], as well as guineafowl [*Numida*],--all historically introduced--could usually be distinguished.)

Large Galliform.....member(s) of an indeterminate family (---although, in Hawai'i, most likely all historically introduced members of the family Phasianidae---) in the general size range of *Meleagris gallopavo* (Wild [and Domestic] Turkey; introduced to the Hawaiian Islands in 1788) and *Pavo cristatus* (Common Peafowl; introduced here in 1860).

Order Gruiformes

Family Rallidae: (Rails, Moorhens or Gallinules, Coots, etc.)

Fulica cf. alai (Hawaiian Coot).....osteologically probably indistinguishable from *Fulica americana* (American Coot); which is a rare visitant to the Hawaiian Islands.

Gallinula chloropus (Common Moorhen)

Medium Rallid.....member(s) of the family Rallidae in the general size range of *Gallinula chloropus* (Common Moorhen) and *Fulica* spp. (coots); most of the material probably consists of certain bones of 1 or both of the 2 Hawaiian species of these types of rallids that I cannot satisfactorily distinguish, especially when the material is fragmentary.

Order Charadriiformes

Family Charadriidae: (Plovers and Dotterels)

Pluvialis fulva (Pacific Golden-Plover).....this relatively common migratory species is most abundant--and thus most readily available for capture--in the Hawaiian Islands from August through April, although a few individuals may occasionally be found here all year.

Order Strigiformes

Family Strigidae: (Typical Owls)

Asio flammeus (Short-eared Owl)

Grallistrix sp. (Stilt-Owl).....prehistorically extinct, diurnal, bird-catching member of the family; (see Olson and James 1991:67-81 for the various species represented on the different Hawaiian Islands).

Medium Strigid.....comprises owl material that does not appear to be the sole Hawaiian representative of the family Tytonidae *Tyto alba* (Common Barn-Owl, introduced to the Hawaiian Islands in 1958), but very likely represents either or both the native *Asio flammeus* (Short-eared Owl) and the prehistorically extinct owl genus *Grallistrix* (Stilt-Owls) of Olson and James 1991:67-81 (both family Strigidae), many of whose bones I cannot yet satisfactorily distinguish, especially when fragmentary.

Order Passeriformes

Family Meliphagidae: (Honeyeaters)

Chaetoptila sp. (Kiorea).....a historically extinct species (*angustipluma*) of this genus occurred on Hawai'i, and the same or related species are prehistorically extinct on, at least, Maui and O'ahu. Next to the Hawaiian species of the crow genus *Corvus*, members of *Chaetoptila* are the largest native passeriforms thus far known from the Islands. (See Olson and James 1982:39, and for Maui records James and Olson 1991:80.)

Family Indeterminate

Small Passeriform.....member(s) of 1 or more families of this order ("Perching Birds" or "Songbirds"), up to the general size of cardinals or smaller thrushes; most of the extinct and extant endemic Hawaiian passeriform species (except the medium-sized *Chaetoptila* noted above), as well as almost all of the historically introduced ones, would be of this size.

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Medium Passeriform.....member(s) of this order in the general size range of myna and robin to larger jays; among endemic Hawaiian passeriform species, apparently only the extinct *Chaetoptila* spp. (family Meliphagidae) and, possibly, a very few of the larger prehistorically extinct species of Hawaiian Honeycreepers and Finches (subfamily Drepanidinae of the family Fringillidae; see James and Olson 1991)--as well as a few of the historically introduced species of various families--would be of this size.

Order and Family Indeterminate

Small Bird.....member(s) of indeterminate order and family up through the general size of storm-petrel, quail, plover, sparrow, myna, and thrush; probably a large amount of the material represents passeriforms but smaller native or historically introduced species of 3 or 4 other orders could well be included, also.

Medium Bird.....member(s) of indeterminate order and family in the general size range of shearwater and petrel, tropicbird, night-heron, duck, hawk, junglefowl (=chicken), moorhen and coot, curlew, gull, owl, crow, and so on; in Hawai'i, probably no passeriforms other than Hawaiian species of the genus *Corvus* would be included, but a number of native or historically introduced species of up to a half-dozen other orders could potentially be.

Large Bird.....member(s) of indeterminate order and family in the general size range of albatross, booby, frigatebird, goose, eagle, turkey, raven, and so on; in Hawai'i, a number of native or historically introduced species of up to a half-dozen orders could potentially be included.

CLASS MAMMALIA [Insofar as possible, arrangement and nomenclature follow Tomich, P.O., 1986, *Mammals in Hawai'i, Second Edition*, Bishop Museum Press, Honolulu; except that the more generally accepted name *Mus musculus* is used here instead of *Mus domesticus*.]

Order Chiroptera

Family Pteropodidae: (Fruit Bats and Flying Foxes)

Small Pteropodid.....member(s) of the family Pteropodidae in the general size range of medium-sized *Dobsonia* (Naked-backed Fruit Bats), small-sized *Pteropus* (Flying Foxes), and *Myotis* (Long-tailed Fruit Bat), the latter 2 of which were at least formerly reported from Micronesia.

Family Vespertilionidae: (Common Bats)

Lasiurus cinereus (Hoary Bat)

Undescribed Vespertilionid Bat.....a prehistorically extinct, apparently endemic, species smaller than the Hoary Bat (*Lasiurus cinereus*) and thus far known from 4 of the main Hawaiian Islands.

Order Primata

Family Hominidae: (Humans)

Homo sapiens (Modern Human)

Order Rodentia

Family Muridae: (Old World Rats and Mice)

Rattus exulans (Polynesian Rat).....comprises all material of this Polynesian-introduced species that, because of its relatively small size, could be distinguished with some degree of certainty from corresponding material of the larger *Rattus norvegicus* (Norway Rat) and *R. rattus* (Roof Rat), both historically introduced to the Hawaiian Islands.

Rattus norvegicus and/or *Rattus rattus* (Norway Rat and/or Roof Rat)...comprises all material that, because of its relatively large size, could be distinguished with some degree of

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certainty from that of the smaller *Rattus exulans* (Polynesian Rat); although, except for essentially intact crania, I doubt that isolated skeletal elements of these 2 larger, post-Contact, species can safely be distinguished from each other.

Rattus sp.comprises material presumably all representing this genus but that could not be assigned to either the Polynesian-introducer, *Rattus exulans* (Polynesian Rat) or the historically introduced *R. norvegicus* (Norway Rat) and *R. rattus* (Roof Rat), usually because of either its fragmentary nature or its relative immaturity.

Mus musculus (House Mouse).....introduced to the Hawaiian Islands sometime after 1778.

Order Odontoceti

Family Delphinidae: (Porpoises, Dolphins, etc.), Physeteridae: (Sperm Whales), and/or Ziphiidae: (Beaked Whales)

Small Odontocete.....members(s) of the order Odontoceti (Toothed Whales) up to about 3 m or so in length, thus at least potentially including any of half-dozen or more Pacific porpoise- and dolphin-like species of the family Delphinidae, as well as such odd forms as the 2 tiny physeterids of the genus *Kogia* (Pygmy and Dwarf Sperm Whales).

Order Carnivora

Family Canidae: (Wolves, Dogs, Foxes, etc.)

Canis familiaris (Domestic Dog).....(I doubt that it is possible to distinguish remains of pre-Contact Polynesian dogs from morphologically similar forms of historically introduced ones, although individuals of very large or otherwise osteologically distinct introduced modern breeds of this same species might be successfully identified as such.)

Family Viverridae: (Mongooses, Civets, etc.)

Herpestes auropunctatus (Small Indian mongoose)...introduced to the Hawaiian Islands in 1883.

Family Felidae: (Lions, Tigers, Cats, etc.)

Felis catus (House Cat).....introduced to the Hawaiian Islands sometime after 1778.

Order Perissodactyla

Family Equidae: (Horses, Donkeys, Zebras, etc.)

Equus caballus (Domestic Horse).....member(s) of the family Equidae in the horse size range; although I have referred all such material to this species (introduced to the Hawaiian Islands in 1803), in reality, the similar-sized *Equus asinus* x *Equus caballus* (Mule; introduced or produced locally by at least 1847)--and perhaps even the smaller *Equus asinus* (Donkey; introduced by at least 1825)--could not always be distinguished from it on the basis of most fragmentary material. (In addition, there are apparently no comparative skeletons of Mule, and only a few miscellaneous bones of Donkey, available in Hawai'i.)

Order Artiodactyla

Family Suidae: (Pigs, Babirusa, Wart Hogs, etc.)

Sus scrofa (Pig).....(just as in the case of the Domestic Dog, I doubt that it is possible to distinguish remains of pre-Contact Polynesian pigs from morphologically similar breeds of historically introduced ones, although individuals of extremely large or otherwise osteologically distinct introduced modern breeds of this same species might be successfully identified as such.)

Family Bovidae: (Cattle, Buffalo, Goats, Sheep, etc.)

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Bos taurus (Domestic Cattle).....member(s) of the family Bovidae in the cattle size range; although I have referred all such material to this species (introduced to the Hawaiian Islands in 1793), in reality, other such large bovids as *Bubalus bubalis* (Water Buffalo; introduced about 1881?) and *Bison bison* (North American Bison; introduced in 1968) could not be distinguished from it on the basis of most fragmentary material.

Capra hircus/Ovis sp. (Domestic Goat/Sheep).....comprises fragmentary material from 1 or more smaller historically introduced members of, presumably, the family Bovidae, with the osteologically very similar *Capra hircus* (Domestic Goat; introduced to the Hawaiian Islands in 1778) and *Ovis aries* (Domestic Sheep; introduced in 1791) being the species most likely represented, although *Ovis musimon* (Mouflon; introduced in 1954) is an additional possibility on some Hawaiian Islands. (Except for portions of the cranium, I doubt that isolated, often fragmentary, bone material of these 2 genera can safely be distinguished, considering both their general skeletal similarity and the osteological variation occasioned by possible interbreeding with and among the different breeds of domestic stock.)

Family Indeterminate

Medium Artiodactyl.....member(s) of indeterminate family, other than Suidae (=pig); although on most isolated Pacific islands the possibilities (all historically introduced) are probably limited to Cervidae (various deer) and smaller Bovidae (*Capra hircus* [Domestic Goat] and *Ovis aries* [Domestic Sheep]); however, in Hawai'i, *Antilocapra americana* (Pronghorn) of the family Antilocapridae, as well as the bovid *Ovis musimon* (Mouflon)--introduced here in 1959 and 1954, respectively--must additionally be considered.

Order and Family Indeterminate

Small-to-Medium Mammal.....member(s) of indeterminate order and family in the general size range of wallaby, rabbit, dog, and cat; in Hawai'i, Polynesian- or historically introduced species of at least 3 orders could potentially be included.

Medium Mammal.....member(s) of indeterminate order and family in the general size range of human, porpoise, seal, pig, deer, and goat/sheep; in Hawai'i, native or introduced species of at least 4 orders could potentially be included.

Large Mammal.....member(s) of indeterminate order and family in the size range of medium and large whales, horse, mule, donkey, and cattle; native or historically introduced species of up to 4 orders could potentially be included.

CLASS INDETERMINATE

Order and Family Indeterminate

Small Vertebrate.....comprises highly fragmented bone material representing member(s) of indeterminate class, order, and family, but with an estimated head-and-body length less than about 0.3 m.

Medium Vertebrate.....comprises highly fragmented bone material representing member(s) of indeterminate class, order, and family but with an estimated head-and-body length of from about 0.3 m to, roughly, 2.0 m.

Large Vertebrate.....comprises highly fragmented bone material representing member(s) of indeterminate class, order, and family, but with an estimated head-and-body length of more than about 2.0 m.

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